Some Real Applications for Negative Materials

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The new near field technologies, Negative Index Materials (NIM) and plasmonics combined with innovation in high dielectric antennas, wireless systems and photonic circuits open the prospect of novel new antennas, integrated circuits, sensors (chemical, biological and individual molecule), medical scanners, displays and imagers which have the potential to outperform conventional technology and open many new commercial opportunities [1]. Rapid developments are now taking place in the development and manufacture of metamaterials for antennas, medical imaging and the management of RF near fields. The interaction of surface plasmons with photonic systems is now being exploited and combined with the maturing photonic crystal technology (PCT) to offer the prospect of near field photonic systems for sensors, displays and communications.

We review the potential impact that these emerging technologies may have on real products and systems. By assessing the performance requirements and the maturity of the technologies we identify the challenges that must be overcome to realise genuine world beating products and speculate on how totally new thinking will be needed to design systems which can exploit the new physics that is emerging.

A number of large technical challenges are ahead in the development of the new technologies. These include reducing loss, increasing isotropy and moving to volume manufacture. Incumbent technologies have shown impressive resilience in meeting new commercial and technological challenges. The massive infrastructure investment and the difficulty in making substantial structural changes in system designs and protocols means that a radical new technology has to show substantial advantage before it can be seriously considered as a contender. We look at how far NIMs amd Plasmonics / Photonic Crystal Technology has to develop to challenge on the real applications stage.

[1] A. J. Holden, “Inside the Wavelength, Electromagnetics in the Near Field, State of the Science Review for DTI Foresight, UK, February 2004, available at: http://www.foresight.gov.uk/